CLAIMS:

1. A method for coding a signal frame at a transmitter using a Karhunen-Loeve transform (KLT), comprising the steps of:

estimating KLT basis vectors of the signal frame;

calculating KLT coefficients of the signal frame; and

transmitting at least one of the KLT coefficients, but not the KLT basis vectors, to a receiver.

2. The method of Claim 1, wherein, at the transmitter, the step of transmitting comprises:

quantizing the KLT coefficients; and

encoding the KLT coefficients.

3. The method of Claim 1, wherein the step of transmitting comprises discarding KLT coefficients that are equal to zero.

4. The method of Claim 1, wherein the steps of estimating, calculating, and transmitting are repeated for a plurality of signal frames.

5. The method of Claim 1, wherein the step of estimating KLT basis vectors comprises:

calculating an intermediate autocorrelation matrix using the signal frame, initial KLT basis vectors, initial KLT eigenvalues, and a search direction vector;

solving a generalized eigenvalue problem to determine eigenvectors of the

intermediate autocorrelation matrix; and

updating the KLT basis vectors using the eigenvectors of the intermediate autocorrelation matrix.

6. The method of Claim 4, wherein the step of estimating KLT basis vectors comprises:

calculating an intermediate autocorrelation matrix using the signal frame, previously stored KLT basis vectors, previously stored KLT eigenvalues, and a search direction vector;

solving a generalized eigenvalue problem to determine eigenvectors and eigenvalues of the intermediate autocorrelation matrix; and

updating the previously stored KLT basis vectors and the previously stored KLT eigenvalues using the eigenvectors and eigenvalues of the intermediate autocorrelation matrix.

7. The method of Claim 1, wherein the step of transmitting further comprises transmitting an index into a codebook of search direction vectors, and

wherein the step of estimating KLT basis vectors at the transmitter comprises:

selecting a search direction vector using a previously stored codebook;

calculating an intermediate autocorrelation matrix from the signal frame, initial KLT basis vectors, initial KLT eigenvalues, and the search direction vector;

solving a generalized eigenvalue problem to determine eigenvectors and eigenvalues of the intermediate autocorrelation matrix;

computing a sum of the eigenvalues of the intermediate autocorrelation matrix;

repeating the steps of selecting, calculating, solving, and computing for all search directions in the codebook;

determining an optimal codebook index of the search direction vector for which the sum of the eigenvalues is greater than all other search direction vectors in the codebook; and

updating the KLT basis vectors using the eigenvectors of the intermediate autocorrelation matrix corresponding to the optimal codebook index.

8. The method of Claim 4, wherein the step of transmitting further comprises transmitting an index into a codebook of search direction vectors, and

wherein the step of estimating KLT basis vectors at the transmitter comprises:

selecting a search direction vector using a previously stored codebook;

calculating an intermediate autocorrelation matrix from the signal frame, previously stored KLT basis vectors, previously stored KLT eigenvalues, and the search direction vector;

solving a generalized eigenvalue problem to determine the eigenvectors and eigenvalues of the intermediate autocorrelation matrix;

computing a sum of the eigenvalues of the intermediate autocorrelation matrix;

repeating the steps of selecting, calculating, solving, and computing for all search directions in the codebook;

determining the optimal codebook index of the search direction vector for which the sum of the eigenvalues is greater than all other search direction vectors in the codebook; and

updating the previously stored KLT basis vectors and the previously stored KLT eigenvalues using the eigenvectors and eigenvalues of the intermediate autocorrelation matrix corresponding to the optimal codebook index.

9. The method of Claim 1, wherein the step of transmitting further comprises transmitting additional information indicating a number of the KLT coefficients being transmitted, and

wherein the step of estimating the KLT basis vectors at the transmitter comprises:

determining an estimated signal frame using initial KLT basis vectors, the signal frame, and a subspace dimension;

calculating a error between the signal frame and the estimated signal frame;

repeating the determining and calculating steps until the error reaches a predetermined threshold;

setting a second subspace dimension equal to the subspace dimension for which the error reaches the predetermined threshold;

generating an intermediate autocorrelation matrix using the signal frame and initial KLT eigenvalues; and

estimating the KLT basis vectors by solving a generalized eigenvalue problem using the intermediate autocorrelation matrix.

10. The method of Claim 4, wherein the step of transmitting further comprises transmitting additional information indicating a number of the KLT coefficients being transmitted, and

wherein the step of estimating the KLT basis vectors at the transmitter comprises:

determining an estimated signal frame using previously stored KLT basis vectors, the signal frame, and a subspace dimension;

calculating an error between the signal frame and the estimated signal frame;

repeating the determining and calculating steps until the error reaches a predetermined threshold;

setting a second subspace dimension equal to the subspace dimension for which the error reaches the predetermined threshold;

generating an intermediate autocorrelation matrix using the signal frame and previously stored KLT eigenvalues; and

updating the previously stored KLT basis vectors and previously stored KLT eigenvalues by solving a generalized eigenvalue problem using the intermediate autocorrelation matrix.

11. The method of Claim 2, wherein the step of transmitting further comprises transmitting additional information indicating a number of KLT coefficients being transmitted and a bit allocation scheme, and

wherein the step of estimating the KLT basis vectors of the signal frame at the transmitter comprises:

determining an estimated signal frame using initial KLT basis vectors, the signal frame, and a subspace dimension;

calculating an error between the signal frame and the estimated signal frame;

repeating the determining and calculating steps until the error reaches a predetermined threshold;

setting a second subspace dimension equal to the subspace dimension for

which the error reaches the predetermined threshold;

setting the bit allocation scheme based on the results of the repeating step;

calculating an intermediate autocorrelation matrix using the estimated signal frame, initial KLT basis vectors, an initial autocorrelation matrix, and an initial estimated signal frame; and

estimating the KLT basis vectors by solving a generalized eigenvalue problem using the intermediate autocorrelation matrix.

12. The method of Claim 4, wherein the step of transmitting further comprises quantizing the KLT coefficients, encoding the KLT coefficients, and transmitting additional information indicating a number of KLT coefficients being transmitted and a bit allocation scheme, and

wherein the step of estimating the KLT basis vectors of the signal frame at the transmitter comprises:

determining an estimated signal frame using previously stored KLT basis vectors, the signal frame, and a subspace dimension;

calculating an error between the signal frame and the estimated signal frame;

repeating the determining and calculating steps until the error reaches a predetermined threshold;

setting a second subspace dimension equal to the subspace dimension for which the error reaches the predetermined threshold;

setting the bit allocation scheme based on the results of the repeating step;

updating a previously stored autocorrelation matrix using the estimated signal frame, previously stored KLT basis vectors, the previously stored autocorrelation

matrix, and a previously stored estimated signal frame;

updating the previously stored KLT basis vectors by solving a generalized eigenvalue problem using the intermediate autocorrelation matrix; and

updating the previously stored estimated signal frame.

13. The method of Claim 1, wherein the step of transmitting further comprises transmitting additional information indicating a number of KLT coefficients being transmitted, and

wherein the step of estimating the KLT basis vectors at the transmitter comprises:

calculating the autocorrelation matrix based on the signal frame and an initial autocorrelation matrix;

solving a generalized eigenvalue problem using the autocorrelation matrix to determine the KLT basis vectors.

14. The method of Claim 4, wherein the step of transmitting further comprises transmitting additional information indicating a number of KLT coefficients being transmitted, and

wherein the step of estimating the KLT basis vectors at the transmitter comprises:

calculating an updated autocorrelation matrix based on the signal frame and a previously stored autocorrelation matrix;

estimating the KLT basis vectors by solving a generalized eigenvalue problem using the updated autocorrelation matrix; and

replacing the previously stored autocorrelation matrix with the updated autocorrelation matrix.

15. A transmitter for coding a signal frame using a Karhunen-Loeve transform (KLT), comprising:

an estimator configured to estimate KLT basis vectors of the signal frame;

a calculator configured to calculate KLT coefficients of the signal frame; and

a transmitter configured to transmit at least one of the KLT coefficients, but not the KLT basis vectors, to a receiver.

16. A method for reconstructing a signal frame at a receiver using a Karhunen-Loeve transform (KLT), comprising the steps of:

receiving KLT coefficients, without receiving corresponding KLT basis vectors, from a transmitter;

estimating KLT basis vectors; and

recreating the signal frame from the estimated KLT basis vectors and the received KLT coefficients.

17. The method of Claim 16, wherein, at the receiver, the step of receiving comprises decoding the KLT coefficients.

18. The method of Claim 16, wherein the steps of receiving, estimating, and calculating are repeated for a plurality of signal frames.

19. The method of Claim 16, wherein the step of estimating the KLT basis vectors at the receiver comprises:

calculating an intermediate autocorrelation matrix using the received KLT coefficients, initial KLT basis vectors, initial KLT eigenvalues, and a search direction vector;

solving a generalized eigenvalue problem to determine the eigenvectors and eigenvalues of the intermediate autocorrelation matrix; and

updating the KLT basis vectors using the eigenvectors of the intermediate autocorrelation matrix.

20. The method of Claim 18, wherein the step of estimating KLT basis vectors at the receiver comprises:

calculating an intermediate autocorrelation matrix using the received KLT coefficients, previously stored KLT basis vectors, previously stored KLT eigenvalues, and a search direction vector;

solving a generalized eigenvalue problem to determine the eigenvectors and eigenvalues of the intermediate autocorrelation matrix; and

updating the previously stored KLT basis vectors and the previously stored KLT eigenvalues using the results of solving the generalized eigenvalue problem.

21. The method of Claim 16, wherein the step of receiving further comprises receiving an index into a codebook of search direction vectors, and

wherein the step of estimating KLT basis vectors at the receiver comprises:

selecting a search direction vector from a previously stored codebook using the received codebook index;

calculating an intermediate autocorrelation matrix using the received KLT coefficients, initial KLT basis vectors, initial KLT eigenvalues, and the search

direction vector;

solving a generalized eigenvalue problem to determine the eigenvectors and eigenvalues of the intermediate autocorrelation matrix; and

updating the KLT basis vectors using the eigenvectors of the intermediate autocorrelation matrix.

22. The method of Claim 18, wherein the step of receiving further comprises receiving an index into a codebook of search direction vectors, and

wherein the step of estimating KLT basis vectors at the receiver comprises:

selecting a search direction vector from a previously stored codebook using the received codebook index;

calculating an intermediate autocorrelation matrix using the received KLT coefficients, previously stored KLT basis vectors, previously stored KLT eigenvalues, and the search direction vector;

solving a generalized eigenvalue problem to determine the eigenvectors and eigenvalues of the intermediate autocorrelation matrix; and

updating the previously stored KLT basis vectors and the previously stored KLT eigenvalues using the eigenvectors and eigenvalues of the intermediate autocorrelation matrix.

23. The method of Claim 16, wherein the step of receiving further comprises receiving additional information indicating a number of the KLT coefficients transmitted, and

wherein the step of estimating KLT basis vectors at the receiver comprises:

generating an intermediate autocorrelation matrix using the received KLT

coefficients and previously stored KLT eigenvalues; and

estimating the KLT basis vectors by solving a generalized eigenvalue problem using the intermediate autocorrelation matrix.

24. The method of Claim 18, wherein the step of receiving further comprises receiving additional information indicating a number of the KLT coefficients transmitted, and wherein the step of estimating KLT basis vectors at the receiver comprises:

generating an intermediate autocorrelation matrix using the received KLT coefficients, previously stored KLT basis vectors, and previously stored KLT eigenvalues; and

updating the previously stored KLT basis vectors and the previously stored KLT eigenvalues by solving a generalized eigenvalue problem using the intermediate autocorrelation matrix.

25. The method of Claim 17, wherein the step of receiving further comprises receiving additional information indicating the number of KLT coefficients transmitted and the bit allocation scheme, and

wherein the step of estimating the KLT basis vectors at the receiver comprises:

calculating an intermediate autocorrelation matrix using the KLT coefficients received in the receiving step, initial KLT basis vectors, an initial autocorrelation matrix, and an initial estimated signal frame; and

estimating the KLT basis vectors by solving a generalized eigenvalue problem using the intermediate autocorrelation matrix.

26. The method of Claim 18, wherein the step of receiving further comprises decoding the KLT coefficients and receiving additional information indicating a number of the KLT coefficients transmitted and a bit allocation scheme, and

wherein the step of estimating the KLT basis vectors at the receiver comprises:

calculating an intermediate autocorrelation matrix using the KLT coefficients received in the receiving step, previously stored KLT basis vectors, a previously stored autocorrelation matrix, and a previously stored estimated signal frame;

updating the KLT basis vectors by solving a generalized eigenvalue problem using the intermediate autocorrelation matrix; and

storing the estimated KLT basis vectors, an estimated signal frame, and the intermediate autocorrelation matrix.

27. The method of Claim 16, wherein the step of receiving further comprises receiving additional information indicating a number of KLT coefficients transmitted, and

wherein the step of estimating KLT basis vectors at the receiver comprises:

calculating an autocorrelation matrix using the KLT coefficients received in the receiving step and initial KLT basis vectors;

solving a generalized eigenvalue problem using the autocorrelation matrix to determine the KLT basis vectors;

finding a scalar measure of the change in the KLT basis vectors from a previously stored value;

repeating the calculating, solving, and finding steps until the scalar measure of change reaches a predetermined threshold; and

repeating the previous step a predetermined number of times.

28. The method of Claim 18, wherein the step of receiving further comprises receiving additional information indicating the number of KLT coefficients transmitted, and wherein the step of estimating KLT basis vectors at the receiver comprises:

calculating an updated autocorrelation matrix using the KLT coefficients received in the receiving step, a previously stored autocorrelation matrix, and previously stored KLT basis vectors;

updating the previously stored KLT basis vectors by solving a generalized eigenvalue problem using the autocorrelation matrix;

finding a scalar measure of the change in the KLT basis vectors from the previously stored value;

repeating the calculating, solving, and finding steps until the scalar measure of change reaches a predetermined threshold;

repeating the previous step a predetermined number of times; and

replacing the previously stored autocorrelation matrix with the updated autocorrelation matrix.

29. A receiver for reconstructing a signal frame using a Karhunen-Loeve transform (KLT), comprising:

an input configured to receive at least one of the KLT coefficients at a receiver;

an estimator configured to estimate the KLT basis vectors of the signal frame at the receiver; and

a signal generator configured to recreate the signal frame from the estimated KLT basis vectors and the received KLT coefficients at the receiver.

30. A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform the steps of:

estimating KLT basis vectors of the signal frame;

calculating KLT coefficients of the signal frame; and

transmitting at least one of the KLT coefficients, but not the KLT basis vectors, to a receiver.

31. A computer readable medium containing program instructions for execution on a computer system, which when executed by the computer system, cause the computer system to perform the steps of:

receiving KLT coefficients, without receiving corresponding KLT basis vectors, from a transmitter;

estimating KLT basis vectors; and

recreating the signal frame from the estimated KLT basis vectors and the received KLT coefficients.